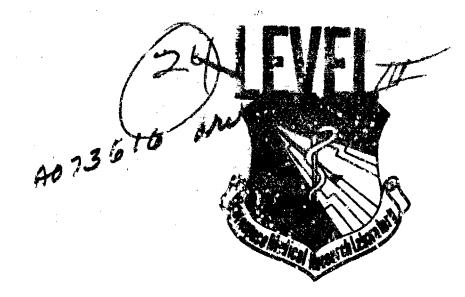
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USAF BICENVIRONMENTAL NOISE DATA HANDBOOK Volume 127 F-15A In-Flight Crew Noise

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AUGUST 1979

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ABBOSPACE MEDICAL RESEARCH LABORATORY
AFROSPACE MEDICAL DIVISION
ALL FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45483

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PREFACE

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under Project/Task 723103, Crew Safety In Operational Noise Environments.

The author acknowledges the efforts of Mr. John N. Cole who established the data analysis requirements, Mr. Henry Mohlman and Mr. Fred Lampley of the University of Dayton who assisted in the mechanics of data processing and Mrs. Peggy Massie who typed this report and prepared it for publication.

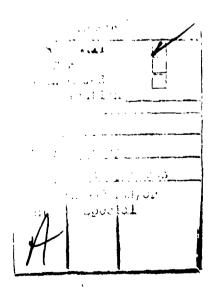


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INTRODUCTION

The USAF F-15A is an air superiority fighter type aircraft manufactured by the McDonnell-Douglas Corporation St. Louis, Mo. Power is provided by two F-100-PN-100 (1) turbofan engines, manufactured by the United Aircraft Corporation, Pratt & Whitney Aircraft Division.

This volume provides measured data defining the bioacoustic environments produced inside the aircraft. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the F-15A.

This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during ground operations of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Refer to Volume 1 (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., in-flight flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and is available upon request from AMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

Direct any questions concerning the technical data in this report and other handbook volumes to: AMRL/BEE, Wright-Patterson AFB, OH 45133: AUTC VON 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

^{1.} Cole, John N., USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application, AMRL-TR-75-50 (1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

IN-FLIGHT NOISE

MEASUREMENTS

All noise measurements were made on-board a F-15A aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard F-15A environments but may not be representative of those levels encountered if the aircraft has been configured differently (e.g., major equipment or structural changes).

Acoustic measurements were made inside the cockpit at the pilot's location. Table 1 lists the measurement location and test conditions as numeric/alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A, etc.

The microphone was attached to the pilot's helmet by means of a lightweight boom. This arrangement enabled adjustment of the microphone close to the ear level at a distance of 0.1 meter with its diaphragin parallel and facing away from the helmet's surface. In the analysis, microphone corrections for random incidence were applied to the overall systems response. The recorded samples were analyzed using a four or eight second integration time to obtain a power-averaged level which effectively smooths out short duration fluctuations and best describes the exposure.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the F-15A aircraft at the specified location. This table includes the overall, ½ octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.

TABLE 1

MEASUREMENT LOCATIONS AND TEST CONDITIONS

F-15A, Nellis AFB, 30 Jan 1979

HEIGHT ABOVE DECK

LOC	CATION 1	POSITION Pilot, Left Side	HEIGHT ABOVE DEC Seated Head Level
CONDITIO	ON	DESCRIP	TION
Α	Ground Runup -	both engines idle, canopy closed, I	ECS Off
В		both engines idle, canopy closed, I	
C	Ground Runup -	both engines idle, canopy open	
D	Ground Runup-	both engines 80% RPM, canopy cle	osed, ECS Off
E	Ground Runup -	-both engines 80% RPM, canopy cle	osed, ECS On
F	Ground Runup -	-both engines 80% RPM, canopy or	pen
G	Takeoff Climb to	10000' - Both Engines A/B	
Н	Descent - 10000	5000′	
1	High Speed Run	-6000' AGL-700 KIAS, 1.2 M	
J	Climb-6000' -	→ 15000' PA - 0.92 M	
K		→ 20000′ PA − 0.88 M	
L	Climb - 20000'	→ 25000′ PA − 0.85 M	
M	Cruise - 25000'	PA - 90% RPM - 0.95 M	
N	Cruise - 25000' I	PA - 1.0 M	
O	Cruise - 25000'	PA-540 KIAS, 12. M	
P	Cruise - 25000' 1	PA – 580 KIAS, 135 M	
Q	Climb - 25000' -	→ 40000 PA – Mil Power	
R	Cruise - 40000'	PA - 0.95 M	
S	Cruise – 40000'	PA – 1.2 M	
T	Cruise - 40000'	PA-460 KIAS 1.4 M	
U	Cruise - 40000' 1	PA - 0.92 M	
V	Descent - 40000	' - 19000' PA – speed brakes or	ut
W	Descent - 19000	' PA → -320 KIAS	
X	Descent - 15000	' PA - 350 KIAS	
Y	Descent - 10000	' PA - 380 KIAS	
Z	Descent-8000'	PA-350 KIAS	
AA	Air Combat Mai	neuver (ACM)	
BB	Initial - 1500'		
CC	360° Pattern – ba	ise to final turn, flaps and gears dow	v n
DD	Landing Roll		

During all flight conditions the EC System was ON except where noted.

क निर्माण किल्ला कि	TABLE: MEA: 2 1/3	MEASURED S 1/3 OCTAVE	ED SOUND P FAVE BAND	RESSUR	EVEL	(00)) IDEN		•• (
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2005	104	96		96	100	3 6	86	2 · 5	90 C	: - C - C - T	* 6	, c	0 G	9 <	\ E
0007	66	95		Q U	4	4	95	*	76	36	P •	. (,	9 6	
9008	1 6	107	102	102	106	101	192	™	<u>م</u>	2	5	r D	10	<u>r</u>	-
(OVERALL	113	110	106	106	109	109	101	101	107	101	115	106	105	4:14	100
													í 1 1 0 1		

TABLE: MEASURES OF HUMA 3	z	NOISE	EXPOSURE	ZE			1					OMEGA TEST	A 3.2	OMEGA 3.2 TEST 78-064-001
NOISE SOURCE/SUBJECT!		90	OPERATION:	Z.			~ ~ ·					2	04 H&Y 79	
F-15A AIRCRAFT IN-FLIGHT CREW NOISE											Î 8 8		- 1	
1/A 1.	1/8 1	1/6	1/0	1/E	1/F	LOCATION/CONDITION 1/G 1/H 1/I	N/COND 1/H	1710N 1/1	1/3	1/K	1/1	1/H	17. N	1/0
HAZARD/PROTECTION C-WEIGHTED OVERALL A-WEIGHTED OVERALL MAXIMUM PERMISSIBLE	SOUND SOUND E TIME	LEVEL CEVEL (T IN	_	NI S	090 097	AT AT NE	SURE	PER UAY	CAFR	161-35,	JULY	73)		
NO PROTECTION OASLC 65 OASLA 82	~ ~ =	103	104 94 85	104 97 50	106 97 50	112 104 15	110 168 8	114 112 3.8	106 106 11	105 103 18	103 102 21	105 104 15	108 107 9	109 109 6
4ELMET WIT F 72	-15	4 4 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	90	91	91	86 74	96	102 21	95	92 120	90	91	93	9.00
Ę	1	154 (A) 81 817	87	87	88	9. 4. 7. 8.	9 9 9 9	98	91 143	24.7	404	339	202	90 170
200 26 96	CUST 89 12	, , , , , , , , , , , , , , , , , , ,	NER 92 120	9 9 9 9	95	101	103 16	117	101	97	95	97	101 25	103
COMMUNICATION PREFERRED SPEECH IN1 PSIL 75 86	0	ERFERENCE 95	E LEVEL 86	L (PSIL 89	IL IN 90	96 96	102	107	100	41	95	86	102	103
ANNOYANCE PERCEIVED NOISE LE TONE CORRECTION (0 PNLT 98 1	LEVEL; (C IN 0	T ONE 08)	CGRRECTED		(PNLT]	IN PNDB)	122	126	121	117	116	118	121 1	124

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

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FOTE (OPERATION!) 1	TABLE: MEASURES O	OF HUMAN	NOI SE	E EXPOSURE	URE) IDENTI	IDENTIFICATIONS OMEGA 3.2	TION
P 1/Q 1/R 1/S 1/T 1/U 1/V 1/M 1/X 1/Y 1/Z 1/Y 1/Q 1/R 1/S 1/T 1/U 1/V 1/M 1/X 1/Y 1/Z	NOISE SOURCE/SUBJEC			OPERATI	ING	! ! !	1 1 6 5 1				i i i i	6 ! ! !	-) -FSI -) RUN -) 31 H		10°-+np
OTECTION OTECTI	IN-FLIGHT CREW NO	ISE	- -) PAGE	E H2	
ERALL SOUND LEVEL (OASLC IN DBC) AT EAR SSIBLE TIME (T IM MINUTES) FOR UNE EXPOSURE PER DAY (AFR 161-35, 3 108 155 104 108 107 105 107 106 105 1 1 108 155 104 108 107 105 107 106 105 1 1 108 155 104 108 107 105 107 106 105 1 1 108 155 104 108 107 105 107 107 106 105 1 1 108 155 104 108 107 105 107 107 106 105 1 2 108 154 157 158 107 101 158 101 120 101 101 101 101 101 101 101 101	1/P	1/Q	1/R	1/5	1/1	170	LOCATIO 1/V	N/CON 1/K	DITION 1/X	17		1/AA	1/88	1/66	1/00
UN PERMISSIBLE TIME (T IN MINUTES) FOR UNE EXPOSURE PER DAY (AFR 161=35, ECTION LC 113 108 155 104 108 107 105 107 106 105 1 LA 111 108 154 155 104 108 107 105 107 106 105 101 1 LA 111 108 154 155 104 108 107 105 107 105 101 1 LA 99 98 98 92 97 96 93 94 94 93 92 92 92 99 98 98 98 98 98 98 98 98 98 98 98 98	HAZARD/PROTECTION C-WEIGHTED OVER A-WEIGHTED OVER	S C				08C	A 4-1								
LC 113 108 155 104 108 107 105 107 105 105 105 105 14,5 8 15 13 8 9 13 11 13 13 13 25 101 14,5 8 15 13 8 9 13 11 13 13 25 101 14,5 8 15 13 8 9 13 11 13 13 25 101 120	MAXIMUM PERMISS NO PROTECTION			-	UTES)					(AFR	161-35	, JULY	73)		
LA 111 108 134 105 108 107 105 106 105 101 14.5 4.5	DASLC 113	108	155	104	108	107	105	107	107	106	105	166	105	104	100
# # 5		108	134	105	108	107	105	166	105	105	101	102	102	86	₹.
P HELMET WITH H-154 P HELMET WITH H-154 36 42 131 120 50 60 101 85 85 101 120 B HELMET WITH H-154(A) P HELMET WITH H-154(A) P HELMET WITH H-154(A) P HELMET WITH CUSTON LINER P HELMET WITH CUSTON LINE P HELMET WITH CUSTON LINE P HELMET WITH CUSTON LINE P HELMET WITH W-154(A) P HELMET WITH H-154(A) P HELMET WITH W-154(A) P HELMET W W W W W W W W W W W W W W W W W W W	T 4.5	∞	4	53	6 0	σ	13	Ħ	13	r) vi	52	77	77	£5	9
LA* 35 95 95 95 95 95 95 95 95 95	HGU-ZAZP HELMET W	IITH H-1	154	8		č	;	ä	č	į	ť	ð	ě	ć	•
P HELMET MITH H-154(A) P HELMET MITH H-154(A) LA* 95 86 85 89 90 89 86 LA* 71 244 404 480 285 339 404 202 177 202 240 P HELMET MITH CUSTOM LINER LA* 176 98 96 98 96 96 100 100 98 97 LA* 176 98 96 96 96 100 100 98 97 TION RRED SPEECH INTERFERENCE LEVEL (PSIL IN DB) L 136 98 96 97 100 100 99 96 IVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNOB) GORRECTION (C IN DB) T 125 124 120 125 123 122 119 123 116		S 5	3 ;	26.	÷ 0	9 9	χ, Τ	ታ !! ፓ 0	± u	20.0	\1 c	# W	7 7	? C	- U
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71 244 404 480 285 339 404 202 177 202 240 P HELMET WITH CUSTOM LINER LA* 176 98 96 98 96 100 100 98 97 11 42 60 60 42 60 50 30 30 42 50 TION RRED SPEECH INTERFERENCE LEVEL (PSIL IN DB) L 136 98 96 97 100 99 96 IVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNOB) CORRECTION (C IN DB) T 125 124 120 125 123 122 119 123 116	OASLA* 95	60	85	70	87	36	85	89	90	83	88	89	87	85	8
P HELMET WITH CUSTOM LINER LA* 176 98 96 98 96 96 100 100 98 97 LA* 176 98 96 96 96 100 100 98 97 TION RRED SPEECH INTERFERENCE LEVEL (PSIL IN DB) L 136 98 96 97 100 100 99 96 IVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNOB) CORRECTION (C IN DB) T 125 124 120 125 123 122 119 123 116		242	404	780	285	339	707	202	170	202	240	202	285	404	619
LA* 176 98 96 96 98 96 96 100 100 98 97 11 42 60 60 42 60 50 30 30 42 50 TION RRED SPEECH INTERFERENCE LEVEL (PSIL IN DB) L 136 98 96 97 100 100 99 96 IVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNOB) CORRECTION (C IN DB) T 125 124 120 125 123 122 119 123 116	HGU-ZA/P HELMET H	ITH CUS	STOM L.	INER											
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TION RRED SPEECH INTERFERENCE LEVEL (PSIL IN DB) L 136 98 96 97 160 96 97 100 100 96 IVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNOB) CORRECTION (C IN DB) T 125 124 120 125 123 122 119 123 116	1 11	45	9	9	745	9	ŝ	30	30	45	20	24	20	77	101
L 136 98 96 97 160 96 97 100 100 99 96 IVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNOB) CORRECTION (C IN DB) T 125 124 120 125 123 122 122 119 123 116			REREN		L (PSI	ži L		•	,	;	;	;	;	:	,
IVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNOB) CORRECTION (C IN DB) T 125 124 120 129 123 123 122 119 123 116		9 9	96	25	100	96	97	100	100	66	96	96	6	26	96
124 120 120 125 123 122 122 119 123 116	AMNOYANCE PERCEIVED NOISE TONE CORRECTION	LEVE	TONE	CORREG	TED (F										
1 2 2 3 3 3 2 4 3	PNLT 125 C	124	120	120	123	123 2	122 3	122	119 2	123	116 3	116	118	113	111

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.